National Institute of Environmental Health Sciences

Climate teleconnections and recent patterns of human and animal disease outbreaks

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Abstract:

Background: Recent clusters of outbreaks of mosquito-borne diseases (Rift Valley fever and chikungunya) in Africa and parts of the Indian Ocean islands illustrate how interannual climate variability influences the changing risk patterns of disease outbreaks. Although Rift Valley fever outbreaks have been known to follow periods of above-normal rainfall, the timing of the outbreak events has largely been unknown. Similarly, there is inadequate knowledge on climate drivers of chikungunya outbreaks. We analyze a variety of climate and satellite-derived vegetation measurements to explain the coupling between patterns of climate variability and disease outbreaks of Rift Valley fever and chikungunya. Methods and Findings: We derived a teleconnections map by correlating long-term monthly global precipitation data with the NINO3.4 sea surface temperature (SST) anomaly index. This map identifies regional hot-spots where rainfall variability may have an influence on the ecology of vector borne disease. Among the regions are Eastern and Southern Africa where outbreaks of chikungunya and Rift Valley fever occurred 2004-2009. Chikungunya and Rift Valley fever case locations were mapped to corresponding climate data anomalies to understand associations between specific anomaly patterns in ecological and climate variables and disease outbreak patterns through space and time. From these maps we explored associations among Rift Valley fever disease occurrence locations and cumulative rainfall and vegetation index anomalies. We illustrated the time lag between the driving climate conditions and the timing of the first case of Rift Valley fever. Results showed that reported outbreaks of Rift Valley fever occurred after ~3-4 months of sustained above-normal rainfall and associated green-up in vegetation, conditions ideal for Rift Valley fever mosquito vectors. For chikungunya we explored associations among surface air temperature, precipitation anomalies, and chikungunya outbreak locations. We found that chikungunya outbreaks occurred under conditions of anomalously high temperatures and drought over Eastern Africa. However, in Southeast Asia, chikungunya outbreaks were negatively correlated (p

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Resource Description

Early Warning System:

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure :

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Extreme Weather Event, Precipitation

Extreme Weather Event: Drought

Geographic Feature:

resource focuses on specific type of geography

Rural, Urban

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Africa, Asia

Asian Region/Country: Other Asian Region

Other Asian Region: South Asia

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Chikungunya, Rift Valley Fever

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment:

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content